APPENDIX D—PAYLOAD FAIRINGS

D.1 ATLAS 4-M PLF (LPF AND EPF)

The Atlas 4-m large payload fairing (LPF) and extended payload fairing (EPF) have a 4.2-m (165-in.) outer skin line diameter cylindrical section. The major sections of these fairings are the boattail, the cylindrical section, and the conical section that is topped by a spherical cap (Fig. D.1-1 and D.1-2). The EPF was developed to support launch of larger volume spacecraft by adding a 0.9-m (36-in.) long cylindrical plug to the top of the cylindrical section of the large payload fairing. All of these sections consist of an aluminum skin, stringer, and frame construction with vertical, split-line longerons that allow the

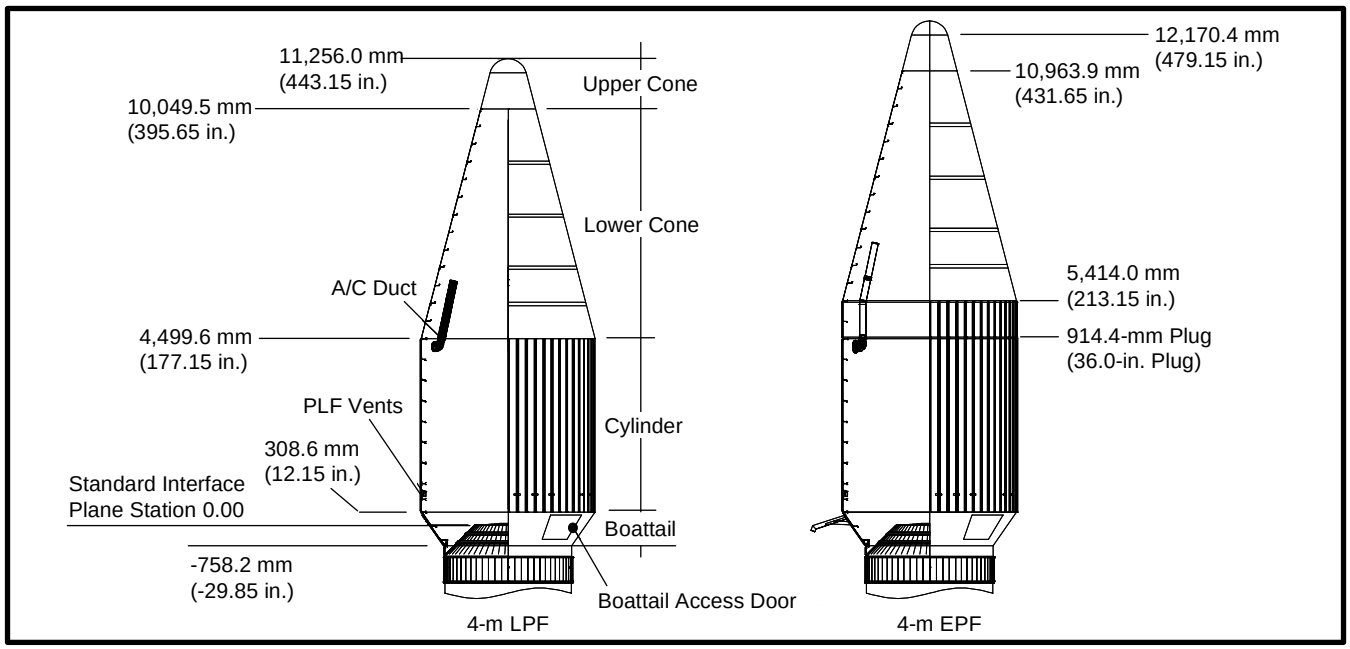


Figure D.1-1 Atlas 4-m Payload Fairings

fairing to separate into bisectors for jettison. Electrical packages required for the fairing separation system are mounted on the internal surface of the boattail. Ducting for the Centaur upper-stage hydrogen tank venting system and cooling ducts for the equipment module packages are also attached to the boattail.

Static Payload Envelope—The usable volume for a spacecraft inside the payload fairing is defined by the static payload envelope. The Atlas 4-m payload fairing provides a 3,750-mm (147.64-in.) diameter envelope in the cylindrical section with additional volume available in the conical section of the payload fairing. On a mission-specific basis, the envelope may be increased to a 3,850-mm (151.57-in.) diameter in localized areas by modifying portions of the payload fairing structure. This envelope represents the maximum allowable spacecraft static dimensions (including)

Figure D-1.2 Atlas 4-m Payload Fairing

manufacturing tolerances) relative to the spacecraft/payload adapter interface. These envelopes include allowances for payload fairing static tolerances and misalignments, payload fairing and spacecraft dynamic deflections, and payload fairing out-of-round conditions, and were established to insure that a minimum 25-mm (1-in.) clearance between the spacecraft and the payload fairing is maintained. These envelopes were developed and are applicable for spacecraft that meet the stiffness and load requirements discussed in Section 3.2.1. Clearance layouts and analyses are performed for each spacecraft configuration and, if necessary, critical clearance locations are measured after the spacecraft is encapsulated inside the fairing to ensure positive clearance during flight. Detailed views of the static payload envelope for the LPF and EPF are shown in Figures D.1-3 to D.1-5.

For customers that request a dynamic payload envelope, the static payload envelopes shown in Figures D.1-3 and D.1-4 can be conservatively used for preliminary design purposes. These envelopes meet the requirements for dynamic payload envelopes of the Evolved Expendable Launch Vehicle Standard Interface Specification. The static payload envelopes were based on a combination of flight, jettison, and ground handling conditions, and the spacecraft dynamic deflections are only a consideration during flight conditions. Mission-specific modifications to these envelopes, either on a static or dynamic basis, are dependent upon the spacecraft configuration and dynamic behavior, and are considered based on analysis performed for each mission.

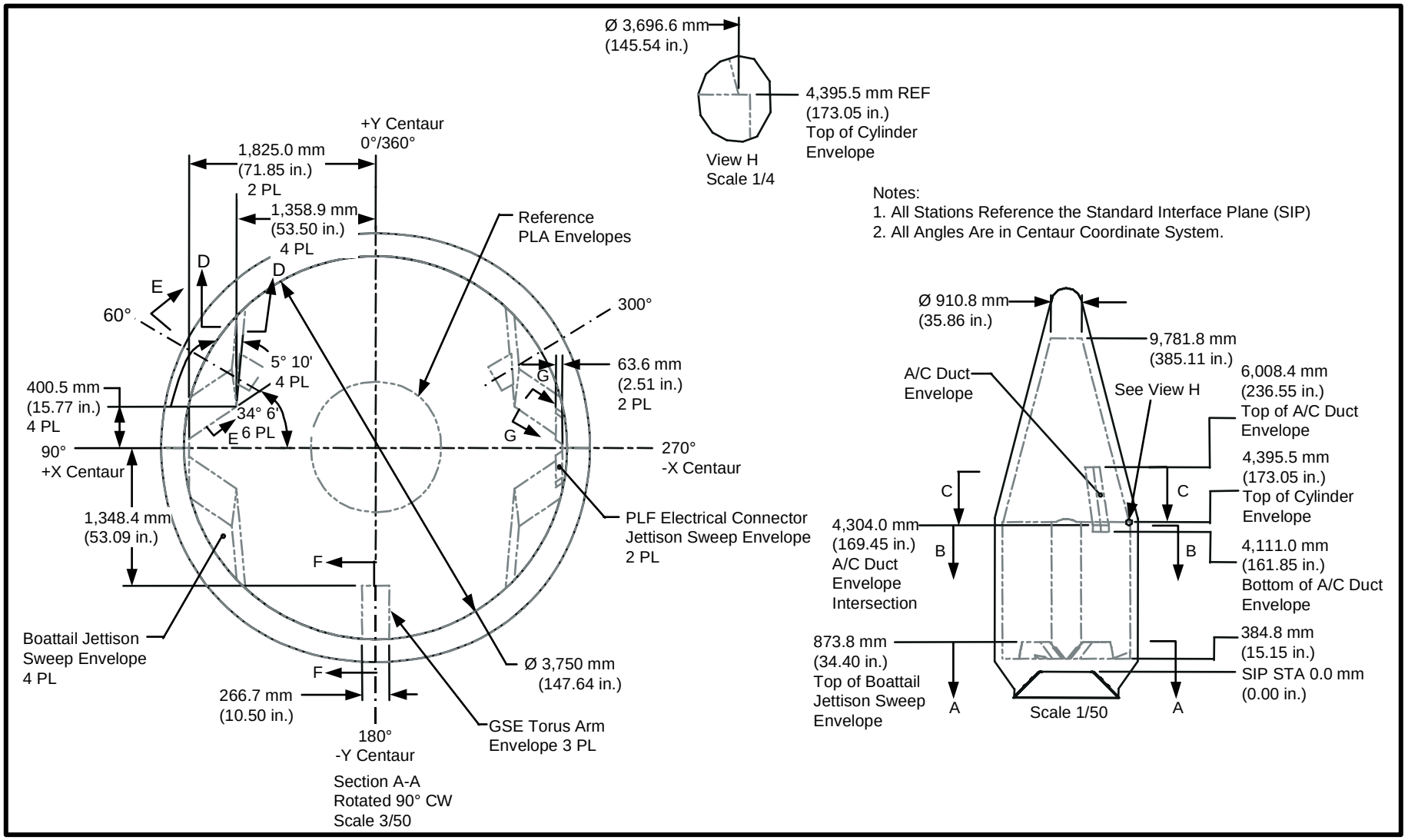


Figure D.1-3 Atlas 4-m LPF Static Payload Envelope

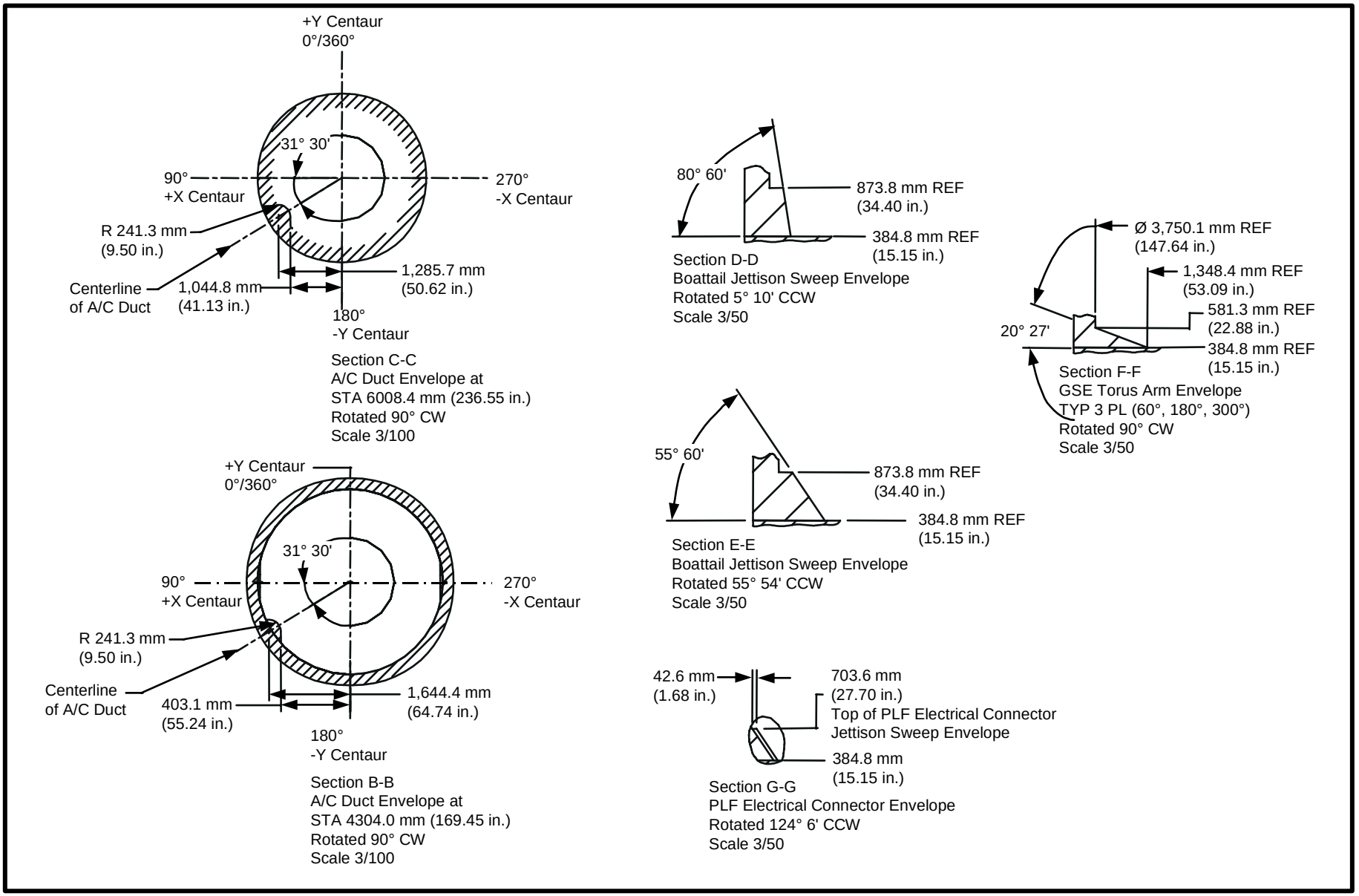


Figure D.1-3 (concl)

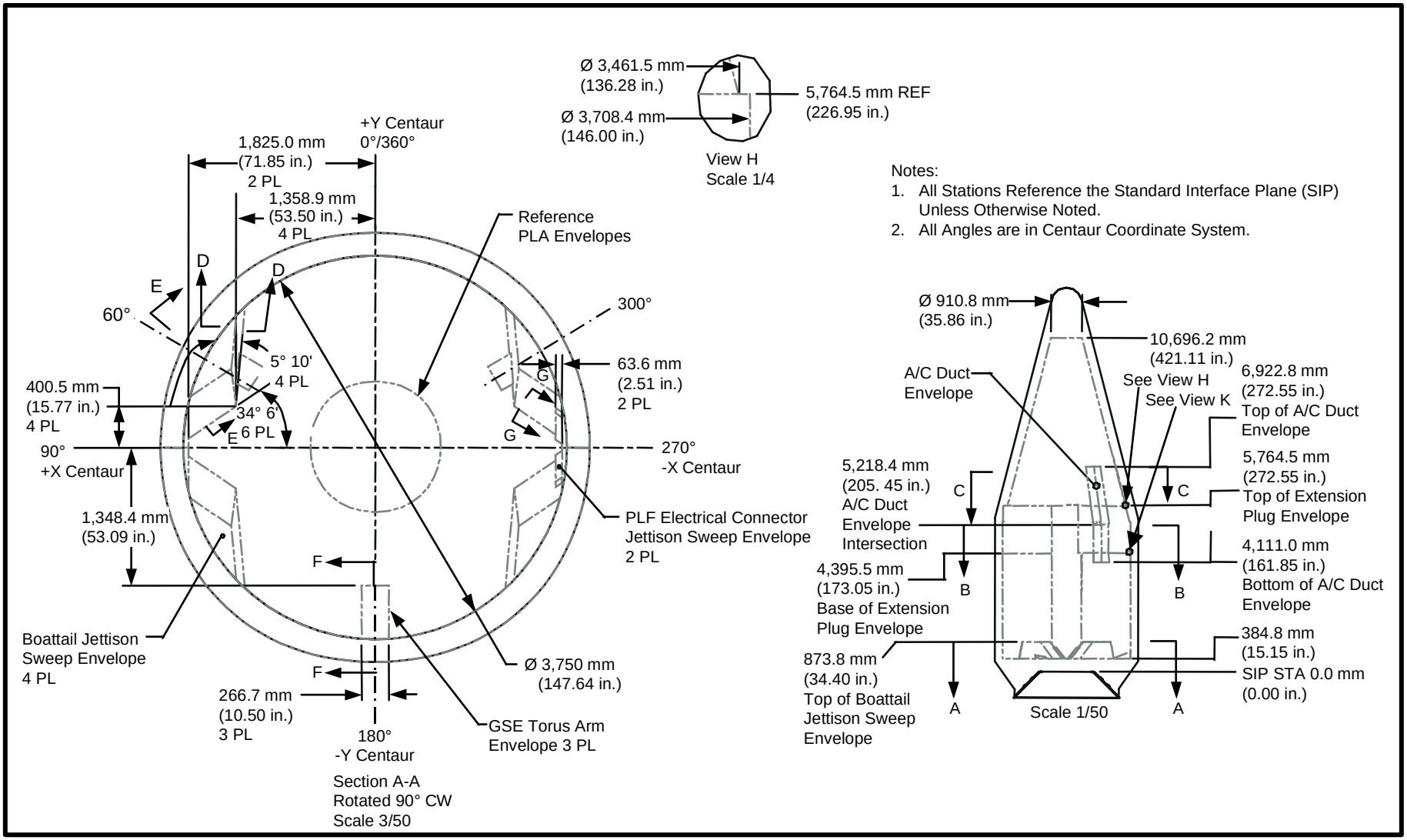


Figure D.1-4 Atlas 4-m EPF Static Payload Envelope

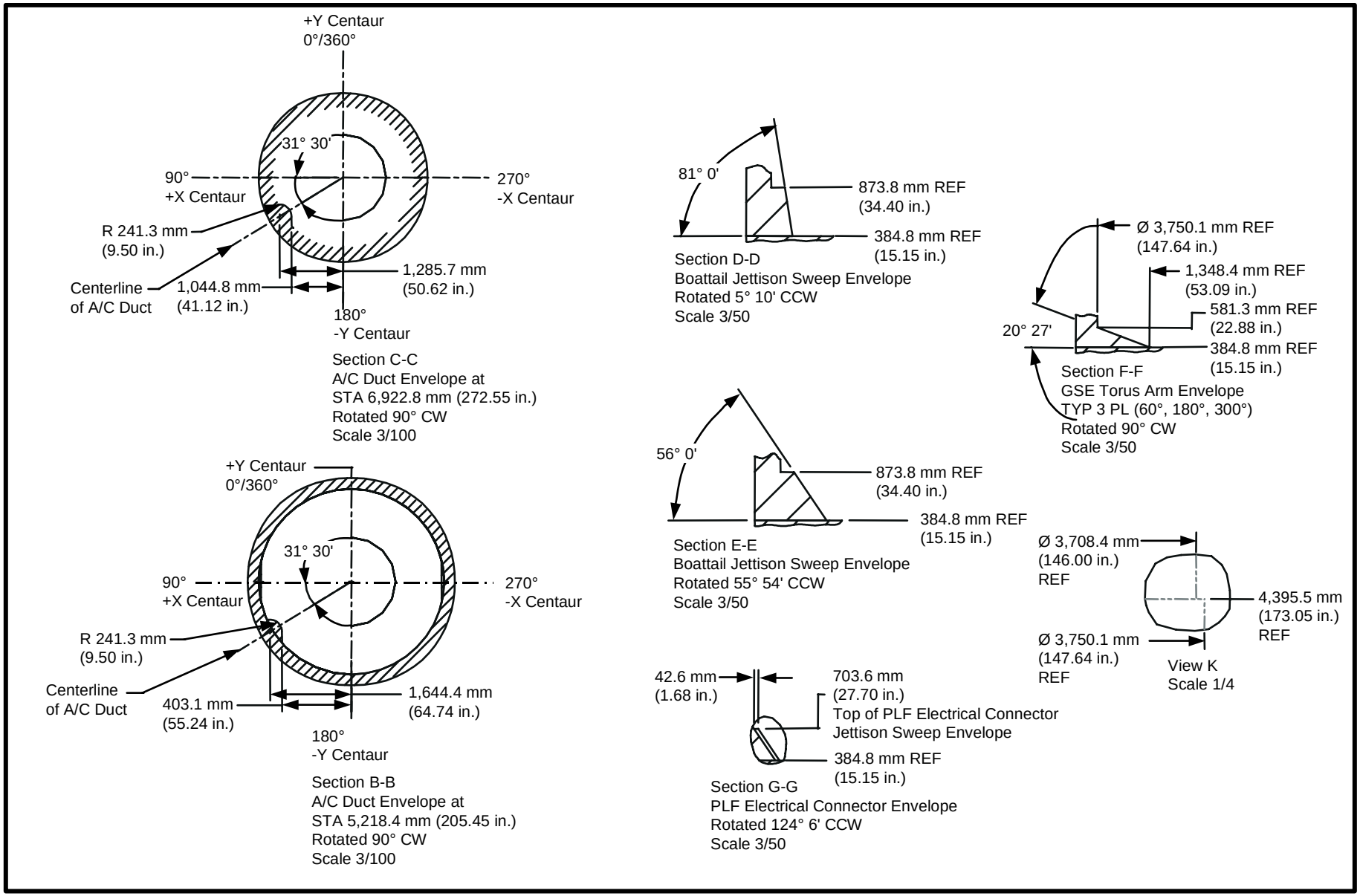


Figure D.1-4 (concl)

Payload Compartment Environmental Control—The Atlas payload fairing is designed to provide a suitable acoustic, thermal, electromagnetic, and contamination controlled environment for the payload. On the Atlas III and Atlas V vehicles, acoustic panels (Fig. D.1-6) are provided on the cylindrical section of the fairing to attenuate the sound pressure levels to acceptable limits (shown in Section 3.2.2). These panels may also be added to the Atlas IIAS vehicle as a mission-specific option. The heritage acoustic panels shown in Figure D.1-6 are being redesigned to be more producible and to reduce infringement on the payload envelope. The new panel design will not change acoustic attenuation characteristics or acoustic levels for the spacecraft.

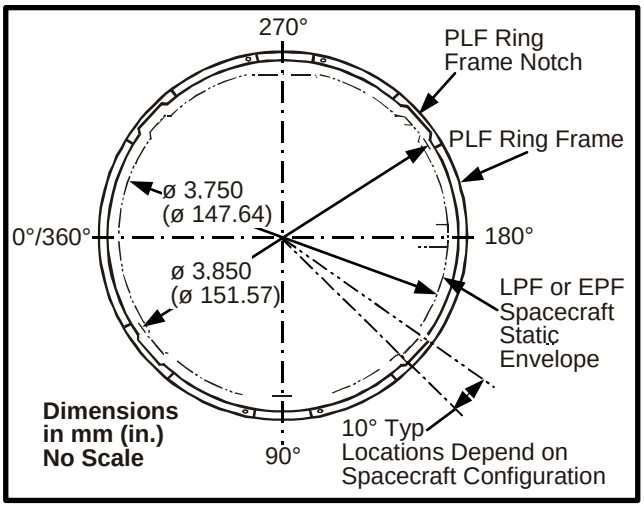


Figure D.1-5 Atlas 4-m PLF Static Payload Envelope, 3,850 mm-Diameter Modification

For thermal control, the external surface of the conical section fairing is insulated with cork to limit temperatures to acceptable values (Sections 3.1.1 and 3.2.5). Noncontaminating, low emittance thermal control coatings are used on fairing internal surfaces to reduce incidental heat fluxes to the spacecraft. The acoustic panels located in the cylindrical section of the payload fairing also serve to reduce heating in the payload compartment. Thermal shields (Fig. D.1-7) may be added in the conical section of the fairing to provide additional thermal control as a mission-specific option. During prelaunch activities,

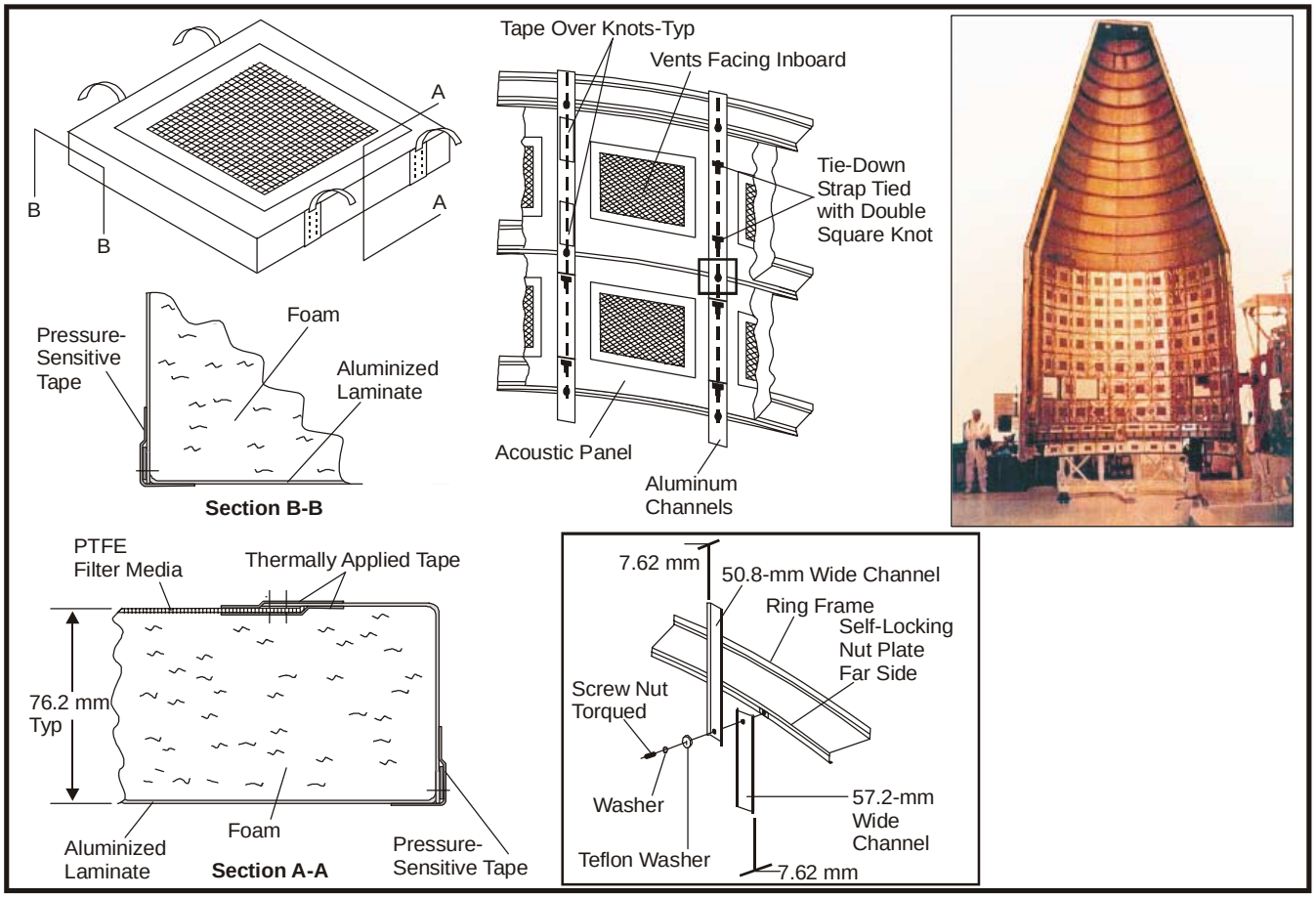


Figure D.1-6 Atlas 4-m PLF Acoustic Panels

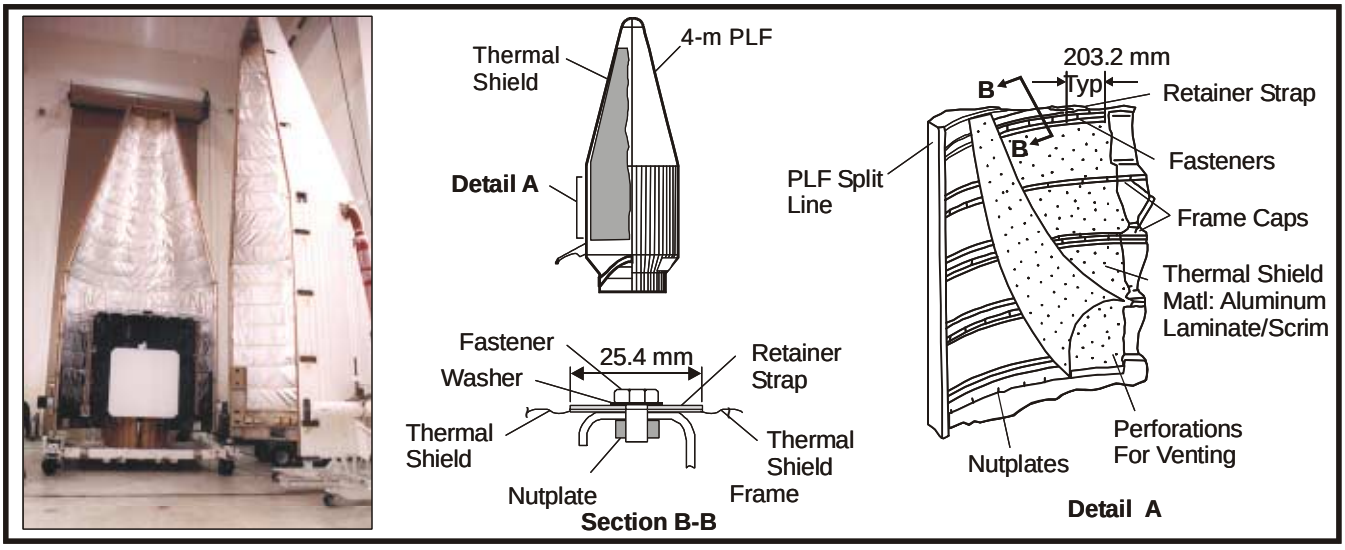


Figure D.1-7 Atlas 4-m PLF Thermal Shields

conditioned air is provided through the air-conditioning duct located in the upper cylindrical and lower conical portion of the fairing. This duct directs conditioned air to provide thermal and humidity control upward into the conical section to avoid direct impingement on the spacecraft. Vent holes and housings are mounted on the lower part of the cylindrical section for the LPF and EPF to allow air from the air-conditioning system to exit the fairing and to allow depressurization during ascent. A secondary environmental control system may be added to provide additional cooling or to direct cooling air to specific points on the payload. This mission-specific option has been used on several missions and design approaches developed for these past missions can be adapted for future applications.

The metallic construction of the fairing provides electromagnetic shielding for the spacecraft and serves to attenuate the external RF environment when it is in place during ground operations. Electrically conductive seal materials are used between mating surfaces on the payload fairing to preclude creating entry paths for RF signals.

The payload fairing is fabricated and operated according to requirements of the Atlas Contamination Control Plan described in Section 3.1.3. This plan establishes rigorous procedures to ensure that all hardware that comes into contact with the payload meets cleanliness requirements and may be tailored to meet mission-specific payload needs.

Payload Access—The four large doors in the boattail section of the 4-m payload fairing (Fig. D.1-8) provide primary access to Centaur forward adapter packages and the encapsulated spacecraft. Work platforms can be inserted into the payload compartment through these doors to allow access to spacecraft hardware near the aft end of the payload compartment. If additional access to the spacecraft is required, doors can be provided on a mission-unique basis on the cylindrical section of each payload fairing. The available sizes and allowable locations for these doors are shown in Figure D.1-8. Access is permitted from the time of payload encapsulation until close-out operations before Mobile Service Tower (MST) rollback at LC-36 or Mobile Launch Platform (MLP) transport at LC-41.

Payload RF Communications—A reradiating system allows payload RF telemetry transmission and command receipt communications after the payload is encapsulated in the spacecraft until time of launch. The airborne system consists of an antenna, a mounting bracket, and cabling inside the payload fairing. Reradiating antennas are available in S-, C-, and Ku-bands. The pick-up antenna is mounted on a bracket at a location appropriate for the spacecraft configuration (Fig. D.1-9). This antenna acquires the spacecraft RF signal and routes it via RF cabling to payload fairing T-0 disconnect. A cable runs from the T-0 disconnect to a junction box that routes the signal to a customer-specified location.

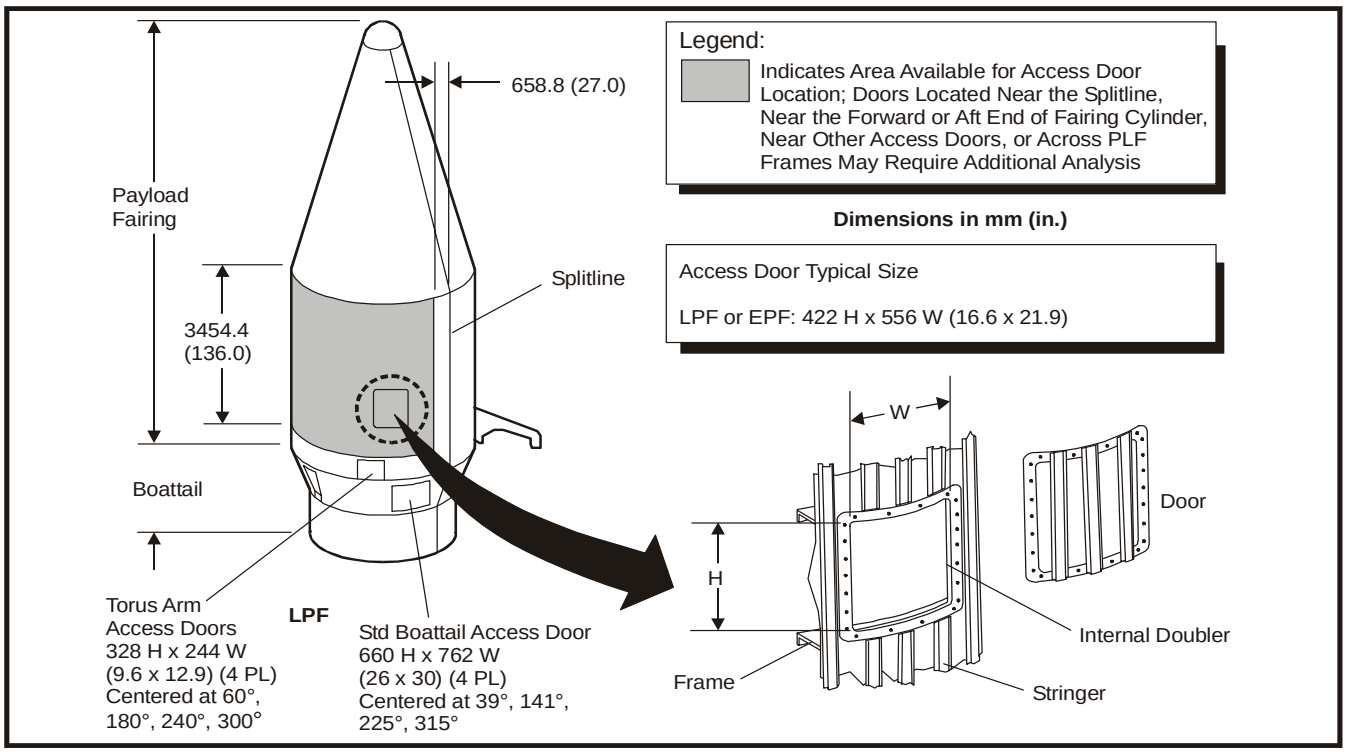


Figure D.1-8 Atlas 4-m PLF Access Doors

Customer Logo—A customer-specified logo may be placed on the cylindrical section of the payload fairing. Logos up to 3.05 x 3.05 m (10 x 10 ft.) are provided as a standard service. The area of the payload fairing reserved for customer logos is shown in Figure D.1-10. The Atlas program will work with the customer and provide layouts of the logo on the launch vehicle to assist in determining their proper size and location.

Figure D.1-9 Atlas 4-m PLF RF Reradiate Antenna Installation

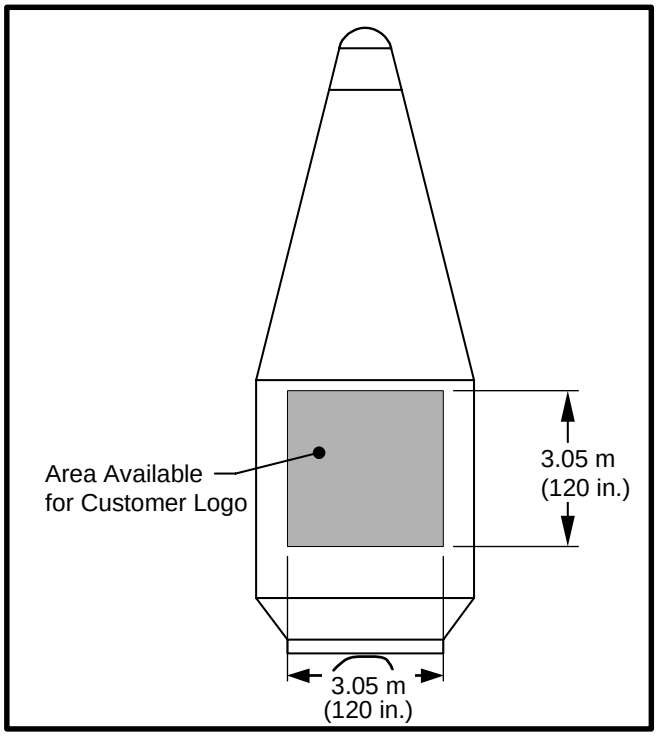


Figure D.1-10 Atlas 4-m PLF Customer Logo Provisions

D.2 ATLAS 5-M PLF (SHORT AND MEDIUM)

The 5-m diameter payload fairing (PLF) was developed along with the increased launch vehicle performance to accommodate growing spacecraft needs. Atlas' 5-m short- and medium-length payload fairings (PLF) have a 5.4-m (213.6-in.) outer skin line diameter cylindrical section. This fairing is a bi-sector fairing with a composite structure made from sandwich panels with composite facesheets and a vented aluminum honeycomb core. This fairing and its associated separation system are derived from an existing flight-proven system. There are two major components of the fairing. The lower section is the base module (BM) that encapsulates the Centaur upper stage. The upper section is the common payload module (CPM) that encapsulates the spacecraft and consists of a cylindrical section that transitions into a constant radius ogive nose section topped by a spherical nose cap (Fig. D.2-1). The ogive shape minimizes aerodynamic drag and buffet. For the 5-m medium payload fairing, a 2,743-mm (108-in.) lower payload module (LPM) is added to the base of the common payload module to increase the available payload volume. The fairing interfaces with the launch vehicle at the fixed conical boattail that is attached to the launch vehicle first stage. Clearance losses for payloads are minimized by the Centaur forward-load reactor (CFLR) system that stabilizes the top of the Centaur, thereby reducing the relative motion between the PLF and payload. The PLF sections provide mounting provisions for various secondary systems. Payload compartment cooling system provisions are in the ogive section of the fairing. Electrical packages required for the fairing separation system are mounted on the internal surface of the fairing.

Static Payload Envelope—The useable volume for a spacecraft inside the payload fairing is defined by the static payload envelope. The Atlas 5-m payload fairing provides a 4,572-mm (180-in.) diameter envelope in the cylindrical section with additional volume available in the ogive section of the payload fairing. This envelope represents the maximum allowable spacecraft static dimensions (including manufacturing tolerances) relative to the spacecraft/payload adapter interface. These envelopes were established to insure that a minimum 25-mm (1-in.) clearance between the spacecraft and the payload fairing is maintained and include allowances for payload fairing static tolerances and misalignments, spacecraft-to-payload fairing dynamic deflections, and payload fairing out-of-round conditions. These envelopes were developed and are applicable for spacecraft that meet the stiffness and load requirements discussed in Section 3.2.1. Clearance layouts and analyses are performed for each spacecraft configuration and, if necessary, critical clearance locations are measured after the spacecraft is encapsulated inside the fairing to ensure positive clearance during flight. Detailed views of the static payload envelope for the 5-m short and 5-m medium payload fairings are shown in Figure D.2-2.

For customers requesting a dynamic payload envelope, the static payload envelopes shown in Figure D.2-2 can be conservatively used for preliminary design purposes. These envelopes meet the requirements for dynamic payload envelopes of the Evolved Expendable Launch Vehicle Standard Interface Specification. The static payload envelopes were based on a combination of flight, jettison, and ground handling conditions, and the spacecraft dynamic deflections are only a consideration during flight conditions. Mission-specific modifications to these envelopes, either on a static or dynamic basis, are dependent upon the spacecraft configuration and dynamic behavior and are considered based on analysis performed for each mission.

Payload Compartment Environmental Control—The Atlas 5-m payload fairing is designed to provide a suitable acoustic, thermal, electromagnetic, and contamination controlled environment for the payload. Fairing acoustic protection (FAP) (Fig. D.2-3) is provided as a standard service to attenuate the sound pressure levels to acceptable limits (Section 3.2.2).

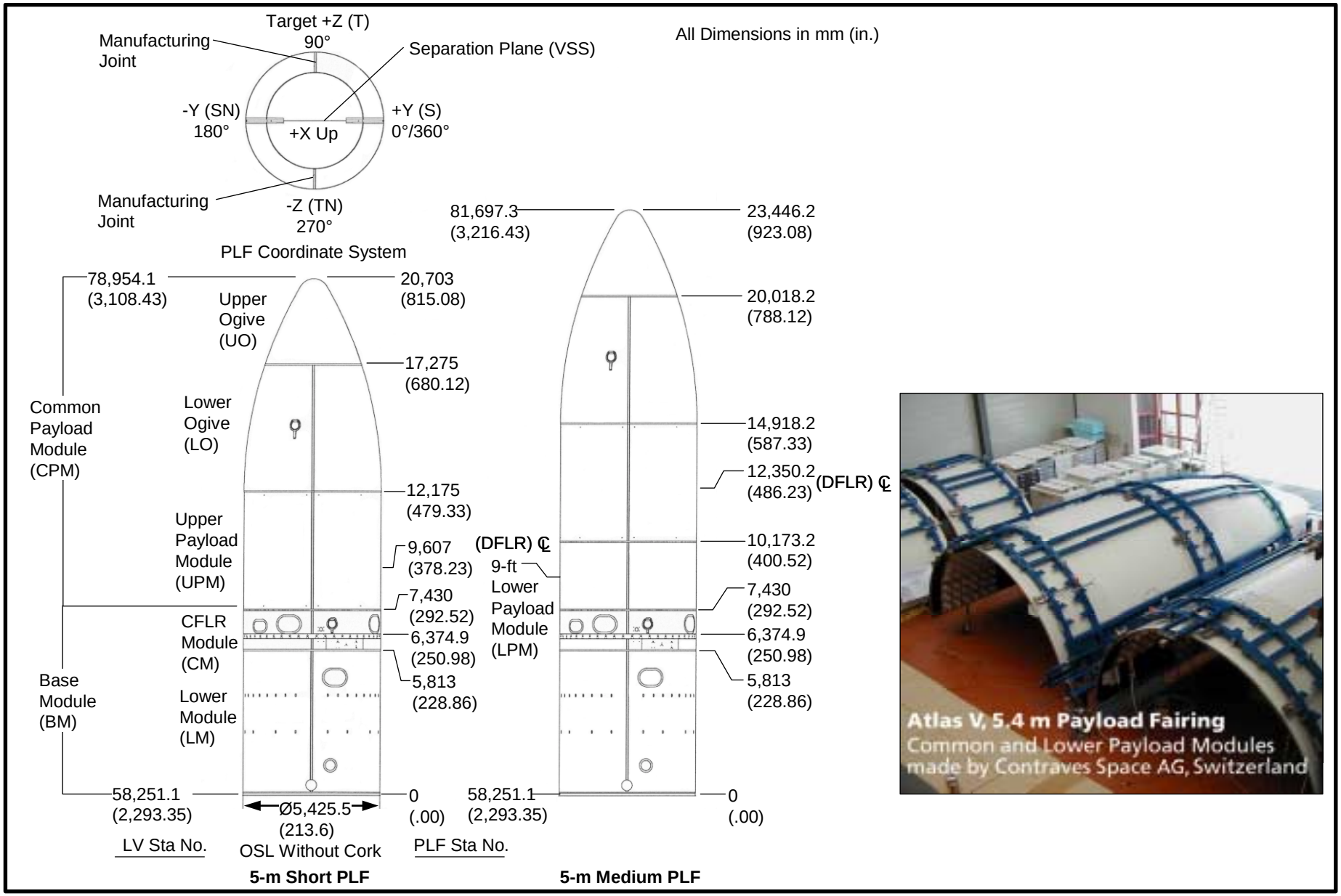


Figure D.2-1 Atlas 5-m Payload Fairing Configurations

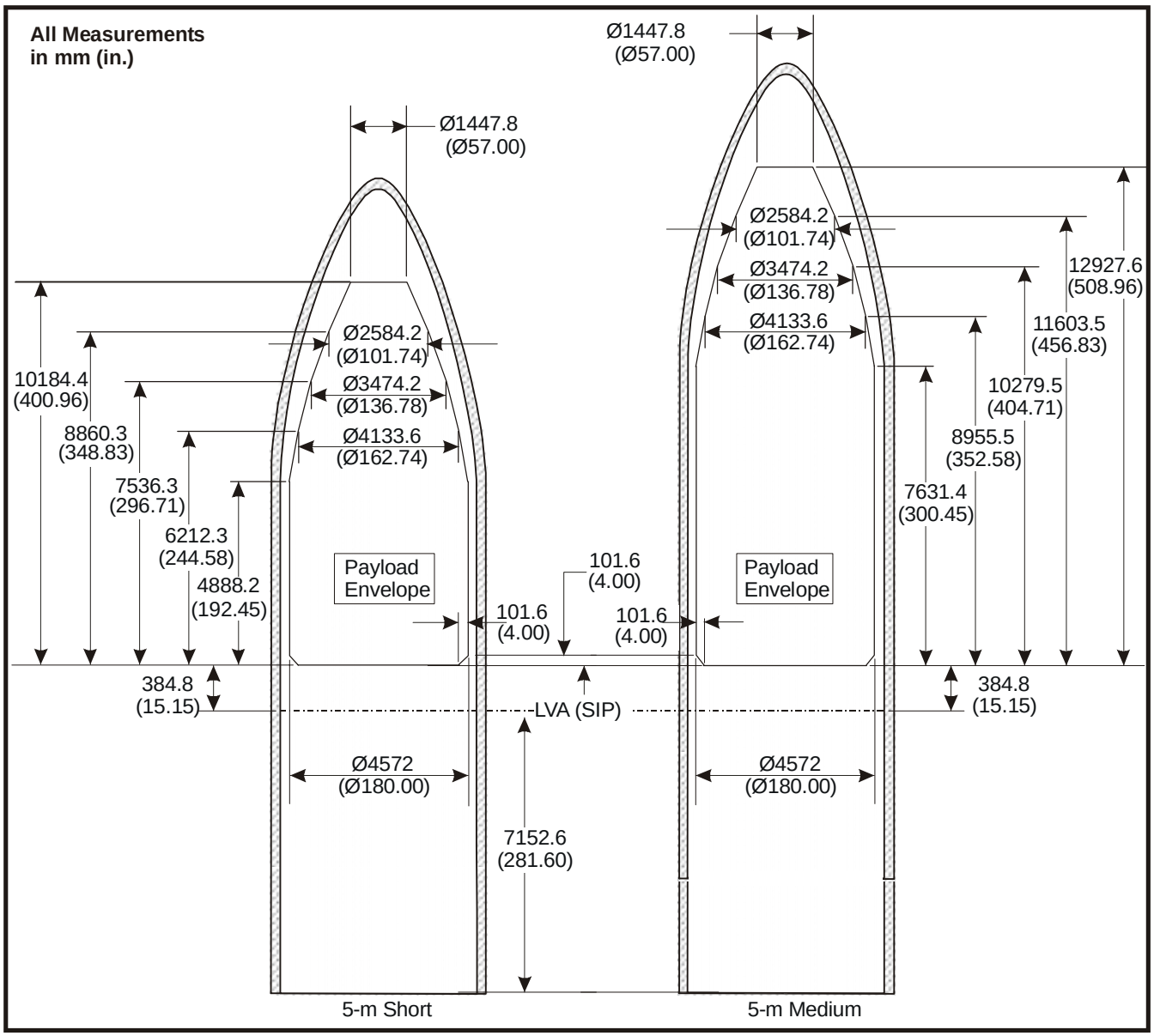


Figure D.2-2 Atlas 5-m PLF Static Payload Envelope

For thermal control, the external surface of the fairing is insulated with cork and painted white to limit temperatures to acceptable values (Sections 3.1.1 and 3.2.5). The fairing acoustic protection panels also serve to reduce heating in the payload compartment. During prelaunch activities, conditioned air is provided through the air-conditioning inlet located in the ogive section of the fairing. This inlet directs conditioned air to provide thermal and humidity control for the payload compartment and prevents direct impingement of this flow on the spacecraft. Vent ports and vent port assemblies are mounted in the mid-section of the base module for air from the air-conditioning system to exit the fairing and to allow depressurization during ascent. A secondary environmental control system may be added as a mission-specific option to provide additional cooling or to direct cooling air to specific points on the payload.

Electrically conductive paint is used on the outside of the payload fairing to prevent electrostatic build-up on the payload fairing.

The payload fairing is fabricated and operated according to the requirements of the Atlas Contamination Control plan described in Section 3.1.3. This plan establishes rigorous procedures to

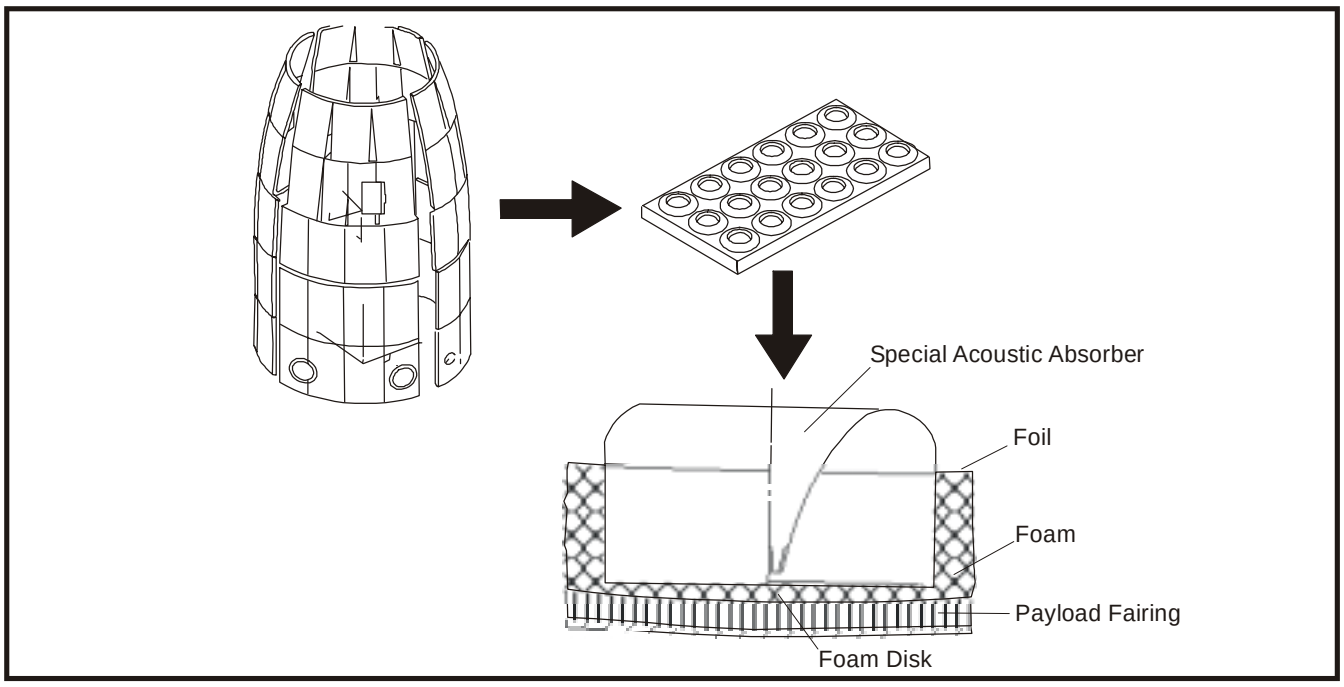


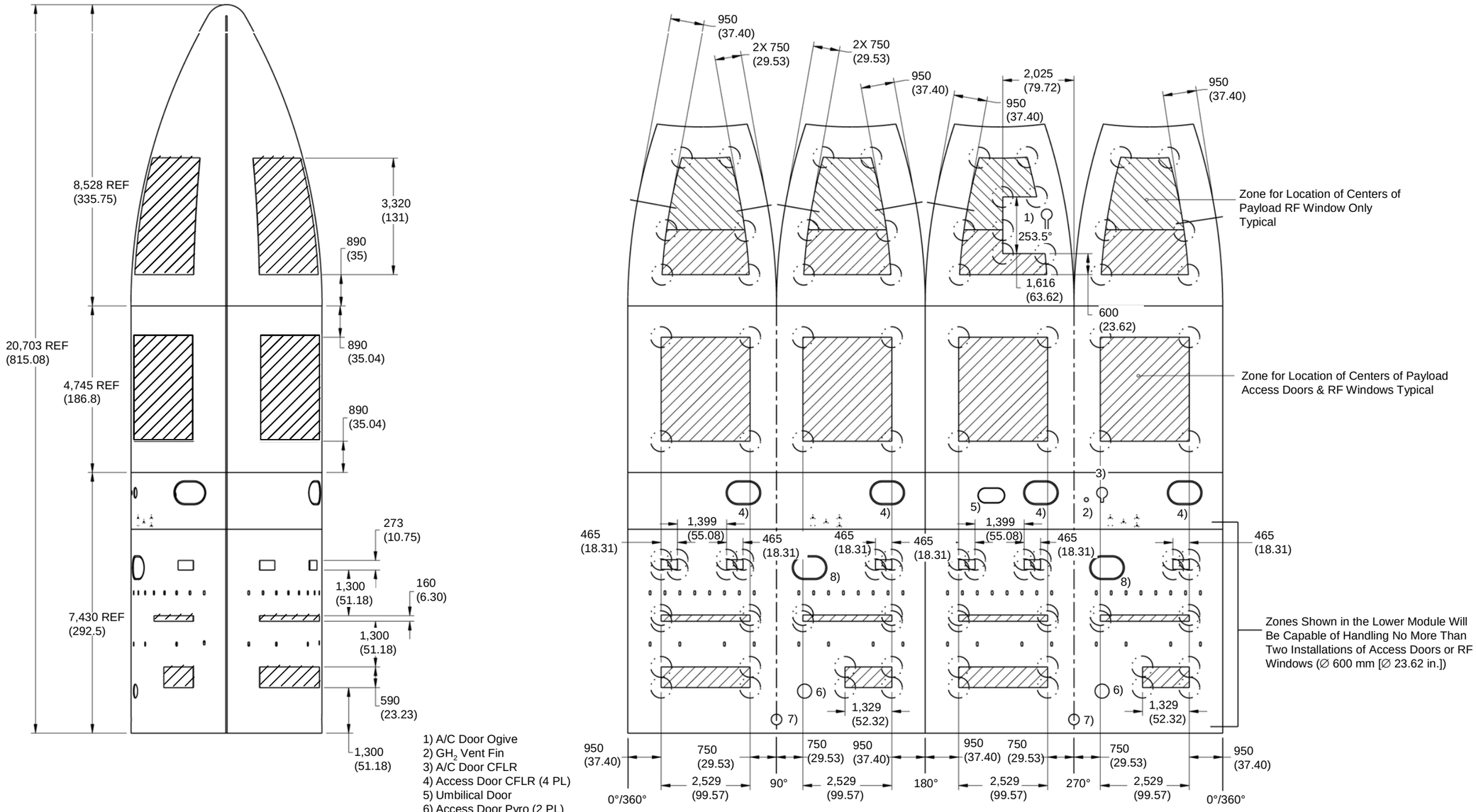
Figure D.2-3 Atlas 5-m Fairing Acoustic Protection

ensure that all hardware that comes into contact with the payload meets cleanliness requirements and may be tailored to meet mission-specific payload needs.

Payload Access—The 5-m payload fairings have four large doors in the base module portion of the payload fairing to provide primary access to the Centaur forward adapter packages and the encapsulated spacecraft. The doors provide an opening of approximately 600 x 900 mm (24 x 36 in.). Work platforms can be inserted through these doors onto the CFLR deck to allow access to spacecraft hardware near the aft end of the payload module. If additional access to the spacecraft is required, additional doors can be provided on a mission-specific basis on the cylindrical and ogive section of the payload fairing. The available sizes and allowable locations for these doors are shown in Figures D.2-4 and D.2-5. Access is permitted from the time of payload encapsulation until close out operations before mobile launch platform (MLP) transport at LC-41.

Payload RF Communications—A reradiating system allows payload RF telemetry transmission and command receipt communications after the payload is encapsulated inside the spacecraft until the time of launch. The airborne system consists of an antenna, a mounting bracket, and cabling inside the payload fairing. Reradiating antennas are available in the S, C, and Ku bands. The pickup antenna is mounted on a bracket at a location appropriate for the spacecraft configuration. This antenna acquires the spacecraft RF signal and routes it via RF cabling to the payload fairing T-0 disconnect. A cable runs from the T-0 disconnect to a junction box that routes the signal to a customer-specified location.

Customer Logo—A customer-specified logo may be placed on the cylindrical section of the payload fairing. Logos up to 3.05 x 3.05 m (10 x 10 ft.) are provided as a standard service. The area of the payload fairing reserved for customer logos is shown in Figure D.2-6. The Atlas program will work with the customer and provide layouts of the logo on the launch vehicle to assist in determining their proper size and location.

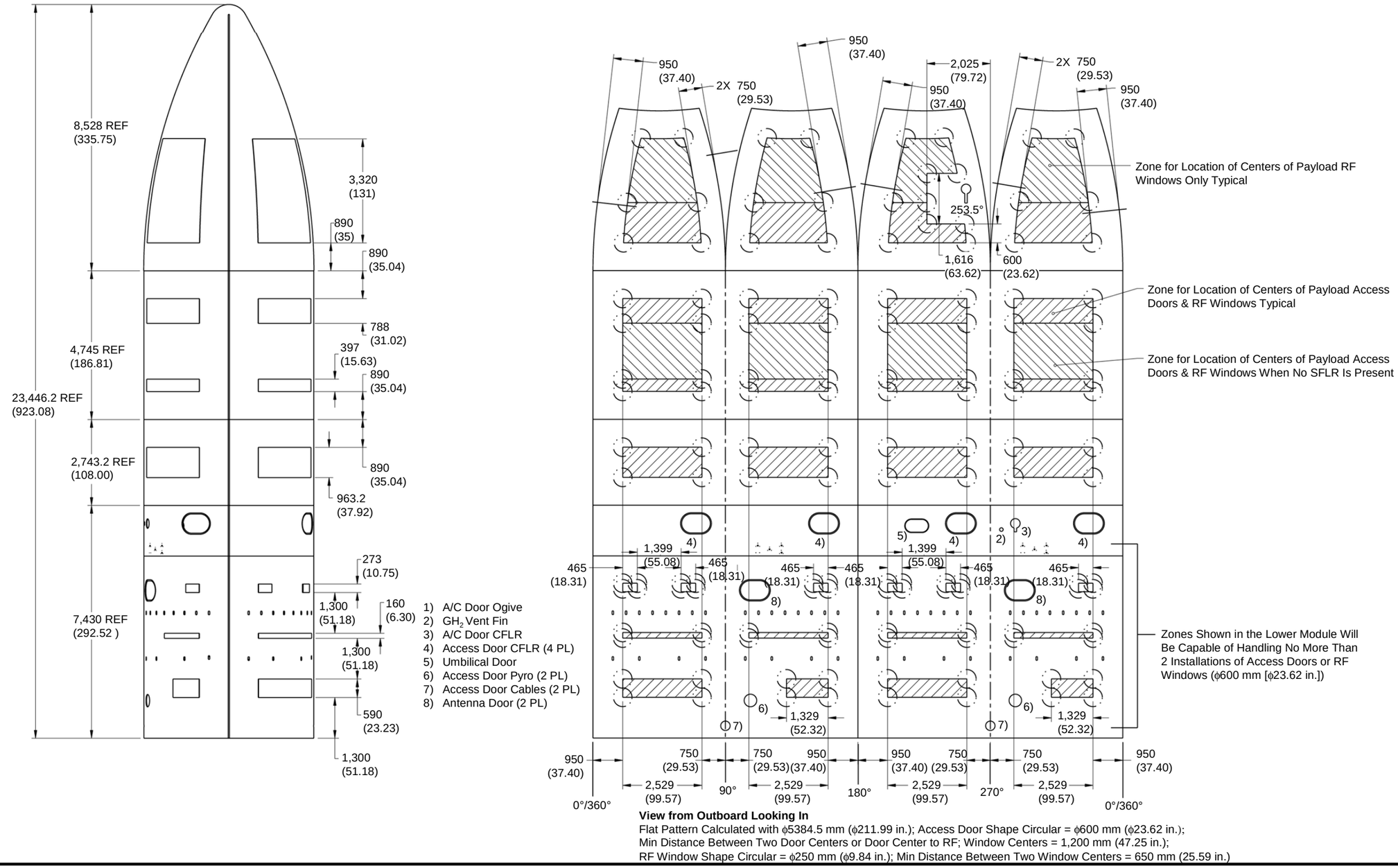


1) A/C Door Ogive
2) GH_2 Vent Fin
3) A/C Door CFLR
4) Access Door CFLR (4 PL)
5) Umbilical Door
6) Access Door Pyro (2 PL)
7) Access Door Cables (2 PL)
8) Antenna Door (2 PL)

All Dimensions in mm (in.)

View from Outboard Looking In
Flat Pattern Calculated with ∅ 5,384.5 mm (∅ 211.99 in.) ; Access Door Shape Circular = ∅ 600 mm (∅ 23.62 in.)
Min Distance Between Two Door Centers or Door Center to RF Window Centers = 1,200 mm (47.25 in.) RF Window Shape Circular = ∅ 250 mm (∅ 9.84 in.) ; Min Distance Between Two Window Centers = 650 mm (25.59 in.)

Figure D.2-4 Atlas 5-m Short PLF Mission-Specific Access Doors



View from Outboard Looking In

Flat Pattern Calculated with ϕ5384.5 mm (ϕ211.99 in.); Access Door Shape Circular = ϕ600 mm (ϕ23.62 in.);
Min Distance Between Two Door Centers or Door Center to RF; Window Centers = 1,200 mm (47.25 in.);
RF Window Shape Circular = ϕ250 mm (ϕ9.84 in.); Min Distance Between Two Window Centers = 650 mm (25.59 in.)

Figure D.2-5 Atlas 5-m Medium PLF Mission-Specific Access Doors

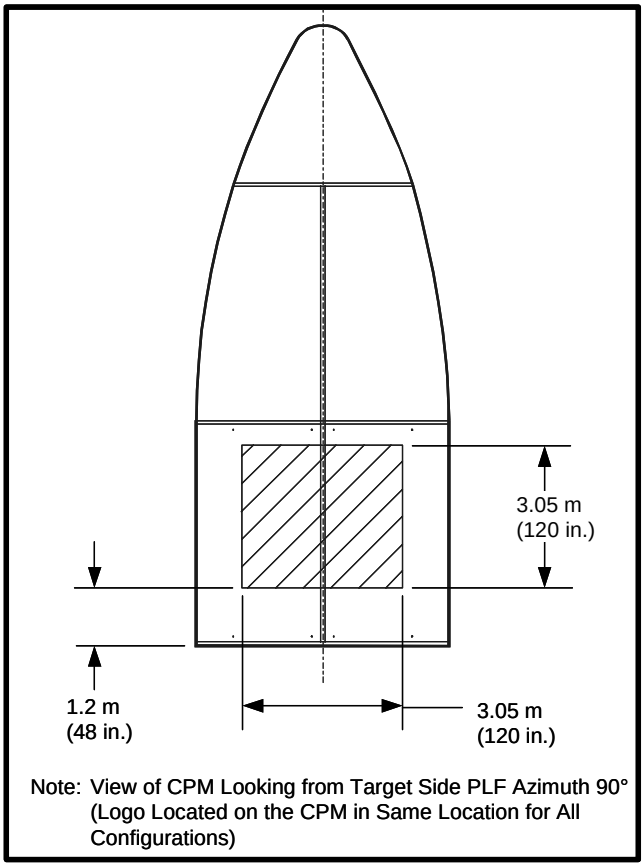


Figure D.2-6 Atlas 5-m PLF Customer Logo Provisions